OPERATION & MAINTENANCE MANUAL
MODEL 15222
RF POWER GENERATOR

MCL/INC
DESIGNERS AND MANUFACTURERS OF RF COMPONENTS AND SYSTEMS
TEN NORTH BEACH • LA GRANGE ILLINOIS 60525 • 312-354-4350

42752-1 thru -4

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7-19-78

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FEATURES

- Plug-in Heads
- Solid State Mainframe
- Short & Open Circuit Protection
- Front Panel Forward & Reflected RF Power Metering
- Regulated Supply Voltages
- Internal Square Wave Modulation
- External Pulse
- External AM Modulation
- Low Tube Cost/Operating Hour
- Variable Power Output
- Direct Reading Frequency Dial
- RF Sample Port

PRODUCT WARRANTY

Under recommended use and service, all MCL products are warranteed against defects in material and workmanship for nine (9) months from the date of original shipment. Material returned after 90 days of the original shipping date will be repaired on a pro-rata basis. MCL's obligation is limited to repairing or replacing, at our plant, products which prove to be defective during the warranty period. Tubes, transistors, and other solid state devices are covered by the respective manufacturer's warranty which applies from the date of shipment of the unit from MCL.

MCL is not liable for consequential damage resulting from the use of MCL equipment.

There will be no charge for repair of units under warranty except non-authorized shipping charges. In the event that responsibility for repair lies with the customer, customer will be charged for the cost of re-testing, repair and shipment. Estimates of charges will be supplied before work begins.

CLAIM FOR DAMAGE IN SHIPMENT
Your unit should be inspected and tested as soon as it is received. Claims for damage should be filed with carrier.

SHIPPING
Upon receipt of shipping instructions, forward the unit to the destination indicated. For non-warranty service, the unit must be shipped prepaid.

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TITLE:

MODEL COMPLEMENT

CW Signal Generator Mainframe, 60Hz_____15222

Control Circuit Board_____15222-1

RF Oscillator Modules:

10-50MHz_____6047
50-200MHz_____6048
200-500MHz_____6049
400-1000MHz_____6050
1000-2000MHz_____6051
2000-2500MHz_____6052

Optional Rack Mount Storage Drawer
for Three RF Modules_____15126

Optional Slides_____30C1724

SPECIFICATIONS

GENERAL

Primary Input Power	115VAC ± 10% @ 5 Amp. max., or 230 VAC ± 10% @ 3 Amp. max, 60 Hz. See Attachment "A" for line voltage conversion.
Controls	Main Power, RF Power Adjust, RF Frequency, Fault Reset, Modulation Select, RF Power Meter Range, RF Power Forward-Reflected
Indicators	Power On, Ready, Grid Overload, AM Modulation Overload, RF Power Meter
Dimensions	19" wide x 7" high x 18" deep
Weight	Less than 50 lbs. without RF Module

RF OSCILLATOR MODULES

Model	Frequency	RF Power Output (nominal)
6047	10-50MHz	100 Watts
6048	50-200MHz	100 Watts
6049	200-500MHz	100 Watts
6050	400-1000MHz	100 Watts
6051	1000-2000MHz	65 Watts
6052	2000-2500MHz	50 Watts

Spurious Output	- Greater than 30dB down (20-2500MHz) Greater than 25dB down (10-20MHz)
RF Sample Output	- 30dB down (nominal)
Power Adjustment Range	- 250mW to maximum rated power.
Modulation Capabilities	- CW, Internal Square Wave, External Pulse, External AM plate modulated
Weight	- 10 lbs. maximum

MODULATION

Internal Squarewave	1KHz ± 10 Hz (internally adjustable ± 100 Hz)
External Pulse	Minimum pulse width 5 microseconds Rise Time 0.6 - 1.1 microseconds Fall Time 0.8 - 1.4 microseconds Input Level, 5 volts into 1000 Ohms
External AM	Frequency range, 150Hz to 10KHz
Percentage of Modulation	Zero to 90%
Input Required	18 Volts RMS into 16 Ohms
Peak Power	Not to exceed maximum rated CW power

TITLE:

DESCRIPTION

1. Introduction

The MCL Model 15222 is a high power RF generator which is completely solid-state except for the long life vacuum tube used in the RF Oscillator Module. This generator covers the frequency range of 10 to 2500MHz with six plug-in RF oscillator heads. RF output power is adjustable over a range of 250mW to the maximum specified power for the head in use. All operating controls and indicators are located on the front panel for ease of operation. Internal modulation capabilities are CW and square wave. External modulation inputs provide pulse and AM modulation operation. The pulse input can also be used to gate the oscillator on for extended time periods since no maximum pulse width or duty cycle is specified.

Protective circuits will return the unit to a fault condition if high load VSWR is present, anode current is exceeded, or the top cover is removed. An RF sample port allows the operator to monitor frequency or the modulated RF signal on external equipment while the generator is operating. Front panel metering displays forward RF power in two ranges and reflected RF power. Panel indicators provide status information for the main power on, ready, grid current overload, and AM modulation overload.

TITLE:

2. Mainframe (15222)

The RF generator mainframe contains the front panel mounted controls and indicators, heater regulator, high voltage power supply and regulator, low voltage power supply transformer, and AM modulation transformer.

3. Control Circuit Board (15222-1)

This printed circuit board plugs into a connector in the mainframe assembly. Low voltage rectifiers and regulation circuits on this board provide the voltage for operation of circuitry on the board, and for the panel indicators. The turn on delay timer, modulator, high VSWR trip, grid current sensing, high voltage regulator driver circuits, and high anode current trip are incorporated on this board.

4. RF Oscillator Module (6047-6052)

The RF oscillator is an easily installed module which contains the RF oscillator cavity, a directional coupler, and calibration controls for the RF power meter. The cavity oscillator is continuously tunable over its frequency range and has an RF output coupling control to optimize operation at any frequency. A dial readout of operating frequency is provided on the front panel. The RF output and RF sample connectors allow easily accessible connection to other equipment.

TITLE:

OPERATION

1. OPERATING CONTROLS AND INDICATORS

All operating controls and indicators are located on the front panel of the RF Power Generator and associated RF Oscillator Modules. Refer to Figure 1 for the location of operating controls and indicators.

1.1 Main Power ON-OFF Switch and Main Power ON Indicator.

This switch controls application of AC line voltage to the RF Power Generator. All circuit power is applied through this switch. An associated Red indicator above the switch lights when the switch is placed in the ON position indicating system power is applied to the circuitry.

1.2 Ready/Reset Switch.

The READY lamp indicates a standby condition. This indicator will light approximately two minutes after AC power is applied indicating high voltage is ready to be applied to the RF oscillator. The RESET switch will reset the fault circuit when operated. A fault is indicated by the READY indicator turning off during operation and the unit becoming inoperative or by the indicator not lighting after the two minute time delay.

TITLE:

1.3 RF Power Output Adj. Control.

Output power of the RF oscillator module is adjusted with this control. The range of adjustment is 250mW to the maximum specified power for the module in use.

1.4 Modulation Switch.

Selection of the operating mode for modulation of the RF carrier is the function of this switch. Internal modulation selection positions are: SQ WAVE which modulates the oscillator with a 1000Hz square wave, OFF which completely disables RF output, and CW which allows the oscillator to operate with no modulation. External modulation positions are: AM which enables the oscillator to be amplitude modulated in the plate circuit to 90% from 150Hz to 10KHz, OFF, and PULSE which allows pulse modulation from a 5 micro-second pulse width to full CW operation.

1.5 Frequency Adj.

Output frequency of the RF oscillator is adjusted with this control located on the panel of the RF Oscillator Module. Frequency will increase with a clockwise rotation.

1.6 Output Coupling.

RF coupling from the oscillator tube to the coaxial output line is adjusted with this control located on the

TITLE:

panel of the RF oscillator module. Coupling should be adjusted for maximum output power at the desired frequency before the RF POWER OUTPUT ADJ. control is set at the exact power desired.

1.7 RF POWER Meter, 100 W-15 W Switch, and FWD-RFL Switch.

RF power output of the cavity oscillator is measured with the RF POWER meter in 15 and 100 watt full scale ranges as selected by the 100 W-15 W range selector switch located at the left side of the power meter. The FWD-RFL switch at the right side of the meter switches the meter from a forward power reading to the reflected power reading calibrated at 15 Watts full scale.

1.8 GRID O'LOAD Indicator.

Grid current in excess of that specified for the RF oscillator head in use will cause the indicator to light, warning the operator that the output coupling adjustment of the RF oscillator is not properly set, or the oscillator is being operated beyond its maximum power specification. Increase coupling to decrease grid current.

1.9 AM O'LOAD Indicator.

External AM modulation in excess of that required for full modulation at the full rated RF output power of the Oscillator Module will cause this indicator to light. The AM O'LOAD indicator is located at the upper left side of the modulation switch. The peak RF Power should never exceed the maximum rated power for the Oscillator Module in use. At RF power levels less than the rated power, it may be possible to over-modulate the oscillator without the overload light showing this overload.

TITLE:

2. CONNECTORS

2.1 AC Power.

Primary power is applied to the signal generator through J403, a standard three conductor male connector located at the rear panel of the unit. The AC power cord plugs into this connector.

2.2 EXT. AM.

External amplitude modulation is applied through this two conductor, 1/4" phone jack to the modulation transformer. This jack is located at the lower right of the MODULATION switch.

2.3 EXT. PULSE.

Pulse modulation from an external source can be applied through this jack. The connector is a BNC type and is located at the lower left of the MODULATION switch. A shielded cable must be used for external connections to this jack.

2.4 RF OUT.

This connector located on the front panel of the RF Oscillator Module is the RF power output of the oscillator. A 50 Ohm type N coaxial connector is used for this purpose.

2.5 RF Sample.

An RF signal which is de-coupled by approximately 30dB from the RF output of the oscillator is available at this jack. This signal can be used for connection to an external frequency counter if greater frequency resolution is required or to an external crystal detector to monitor the modulation characteristics of the unit while it is operating.

3. OPERATING PROCEDURE

3.1 Connections.

The following connections must be made to the RF generator before the unit should be turned on.

3.1.1 Connect the RF OUT jack to the equipment under test or a 50 Ohm coaxial termination with a power rating of 100 watts minimum.

3.1.2 Connect the RF SAMPLE jack to the desired test equipment.

3.2 Initial Settings.

Pre-set the following controls before the unit is turned on.

TITLE:

3.2.1 Set the RF POWER OUTPUT ADJ. control to the RF OFF position.

3.2.2 Set the FWD-RFL switch to the FWD position.

3.3 System Operation.

The following sequence should be followed to activate the unit.

3.3.1 Set the main power switch to ON. The red indicator above the switch will light. After approximately two minutes, the READY/RESET indicator will light.

3.3.2 Adjust the FREQUENCY ADJ. control to the desired operating frequency.

3.3.3 Turn the RF POWER OUTPUT ADJ. control in a clockwise direction until there is an indication on the RF POWER meter, or until a maximum of 40 is attained on the control.

CAUTION:

If the OUTPUT COUPLING is badly misadjusted, no indication of RF power may occur. Do not turn the RF POWER ADJ. control past 40 until an RF indication is obtained. Refer to the next paragraph for output coupling adjustment.

TITLE:

3.3.4 Rotate the OUTPUT COUPLING control for maximum power output.

NOTE: If the adjustment of this control is in question, increase the coupling to maximum as indicated on the panel of the RF oscillator module and gradually decrease the coupling to obtain the maximum power level.

3.3.5 Set the RF POWER ADJ. control to the desired power level and re-peak OUTPUT COUPLING for maximum power output. Repeat this procedure until no power change occurs when tuning the OUTPUT COUPLING.

NOTE:

In most cases, more than the rated output power is available.

3.3.6 The reflected power can be measured by setting the FWD-RFL switch to the RFL position. In the RFL position, the full scale reading is 15 watts regardless of the 100 W - 15 W switch position. The RF Power Generator is designed to operate into a

nominal 50 Ohm termination, and is protected against damage as a result of operation into an open, short or badly mismatched load. If the reflected power exceeds 10 watts, the high voltage will automatically shut off and the READY/RESET indicator will de-activate.

3.4 Modulation.

To operate with internal or external modulation, the following information should be observed.

3.4.1 When operating with the MODULATION switch in the INT or EXT position it is desirable to view the detected waveform on a scope. A detector can be connected to the RF SAMPLE jack for this purpose.

3.4.2 For external pulse application, apply a positive pulse of 5 volts with a pulsewidth of 5.0 microseconds minimum to the EXTERNAL PULSE jack.

3.4.3 For EXTERNAL AM MODULATION apply a modulating voltage of 15.0 VRMS maximum to the EXT AM jack and set the RF POWER OUTPUT ADJ control to just below the level at which the AM O'LOAD indicator flashes on modulation peaks.

4. INTERCHANGING RF MODULES

RF Oscillator Modules may be interchanged to provide various frequency ranges as required. Turn off the main power, re-

TITLE:

move the RF cables from the module, unscrew the two captive screws at the sides, and carefully slide the module from its housing. A new module may now be inserted and locked in position using the screws.

TITLE:

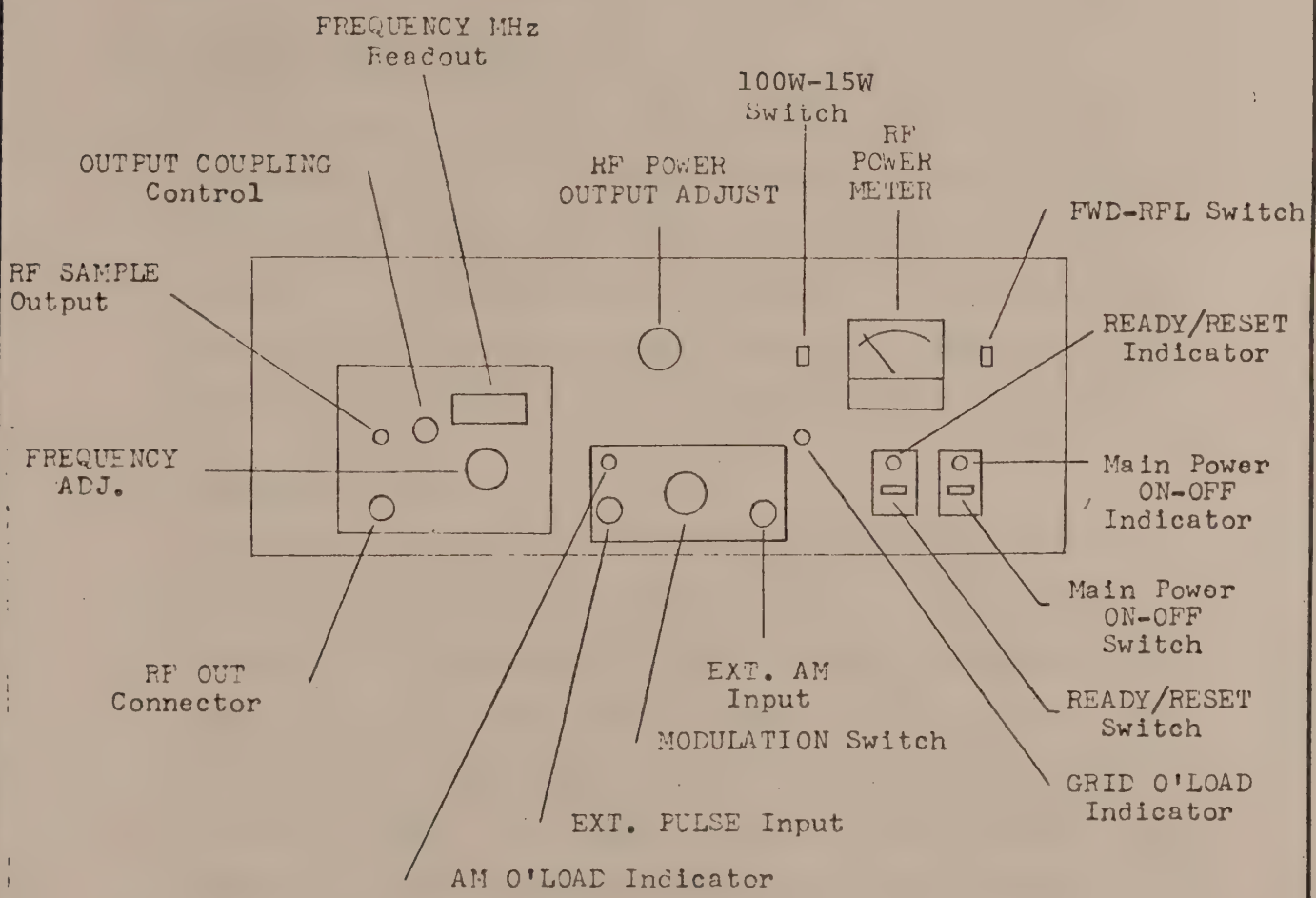


Figure 1

Location Of Operating Controls And Indicators

TITLE:

THEORY OF OPERATION*

*Refer to the Functional Block Diagram and System Schematic Diagram for additional information.

1. PRIMARY POWER DISTRIBUTION

Line voltage from the AC connector J403 on the rear panel is routed through circuit breakers CB401 and CB402 to the main power ON-OFF switch S402. With this switch closed, power is applied to the cabinet blower B401, heater regulator transformer T404, low voltage power supply transformer T402, and to the normally open contact of READY/RESET relay K401.

2. HEATER REGULATOR

The heater regulator is located in the RF Oscillator Module section of the mainframe assembly. Voltage from the low capacitance transformer T404 is rectified and applied to the regulator circuit consisting of Q401 and Q402. Q402 is an integrated circuit regulator which drives the series pass transistor Q401. The output voltage of this regulator is fixed at a nominal 6.0 volts and is not adjustable.

3. LOW VOLTAGE POWER SUPPLIES

Three power supplies on the control circuit board are used to provide power to the control and indicator circuits on the system.

3.1 12 Volt Supply.

Voltage from T402 is applied to pins 1 and 2 of the

printed circuit card connector J406. This voltage is rectified and filtered and applied to the integrated circuit regulator Q301. The output voltage of this regulator is a fixed 12 volts which is utilized in the high voltage regulator driver circuit.

CAUTION:

This circuit operates at the positive anode potential. When measuring, be certain to observe adequate safety precautions.

3.2 15 Volt Supply.

Voltage from T402 is applied to pins N and M of J406 to supply the AC power for this supply. The voltage is rectified, filtered, and applied to the integrated circuit regulator Q304. The output of this regulator is a fixed 15 volts which is used to operate the control and protective circuitry on the Control Circuit Board. Unregulated DC from this supply operates the panel indicator lamps and the READY/RESET relay. Output voltage can be measured from blue test point TP303 (positive) to black test point TP304 (negative).

3.3 55 Volt Supply.

This supply receives voltage from T402 at pins 20 and 21 of J406. A 55 volt nominal output from this unregulated supply is used to operate the cathode modulator circuit. Output voltage can be measured from the green test point

TP302 (positive) to the black test point TP304 (negative).

4. TIMER

The timer circuit provides a two minute turn on delay which inhibits the application of anode voltage to the oscillator tube while it is heating. The timer operates from the regulated 15 volt power supply. The voltage is applied through the RF Oscillator Module, Thermal Relay K701, and chassis interlock S401. A programmable uni-junction transistor (PUT) Q308C generates the delay with timing components consisting of C308, R337, and R339. When the delay period has elapsed, a high is applied to the AND gate Q307C which applies a high to the READY/RESET relay driver. If the RF Oscillator Module is removed or one of the interlocks opens, the 15 volts is removed from the timing circuit, thus preventing it from operating. Removal of this voltage while the unit is in operation after the time delay, will reset the timer and cause the READY/RESET indicator to go out. The system will then start another two minute warm-up cycle before the lamp will again light and the generator can be operated.

5. READY/RESET RELAY AND DRIVER

A high from AND gate Q307C applied to transistor pair Q308D switches the transistor on applying a ground on the relay control line. This low energizes the coil of the READY/RESET relay K401 and also turns on the READY/RESET indicator DS403.

5. When K401 energizes, the relay contacts apply AC power to the adjustable RF POWER OUTPUT ADJ. transformer T403.

6. HIGH VOLTAGE POWER SUPPLY

A continuously adjustable tracking regulator circuit is used to provide the anode voltage for the RF Oscillator Module. The voltage reference level for the regulator is established by R402 and R403. This level is compared in the differential amplifier Q305 with the level set by R312. The differential amplifier output is coupled to the high voltage regulator by optical isolator Q303. Isolation is necessary due to the series pass regulator network operating at voltages up to 1000 volts, and the reference amplifier operating at circuit ground. The high voltage regulator consists of driver transistors Q703-Q706 and series pass regulator transistors Q701 and Q702. The reference voltage control R403 is mechanically coupled to the RF POWER OUTPUT ADJ. transformer T403 to maintain tracking at all operating voltages.

7. MODULATOR

7.1 SQ WAVE Function.

Modulation transformer T405 secondary winding is shorted by modulation switch S404A. Input pin 11 of differential amplifier Q307B is connected to the wiper of SYMMETRY ADJ. control R342 and the input (pin 10) of the amplifier is connected to REPETITION RATE ADJ. control R352 through S404C. These connections allow the amplifier to operate

as a square wave generator which drives cathode modulator transistor Q309.

7.2 OFF Function.

Input offset bias on pin 11 of Q307B is removed and the input is grounded which causes the amplifier to bias Q309 off and turn the RF oscillator tube off.

7.3 CW Function.

Pin 10 of Q307B is grounded to bias Q309 on providing CW operation of the oscillator tube. The modulation transformer secondary is shorted by S404A.

7.4 AM Function.

The modulation transformer T405 is placed in the anode lead to the RF oscillator tube by S404A. The modulator transistor Q309 is biased on by Q307B. Modulation is applied to the oscillator through EXT. AM connector J402. The external modulation circuitry is located in the RF Power Generator mainframe, and consists of a modulation transformer and a peak voltage indicator in addition to portions of a four-position, three-pole switch. The secondary of the modulation transformer is in series with the high voltage power supply and the triode RF oscillator. The voltage at the secondary of this modulation transformer is 707 volts peak to peak (when 15 VRMS is applied to the EXT modulation jack). If the RF POWER OUTPUT ADJ

TITLE:

is set to produce a nominal voltage of 645 volts at the output of the high voltage power supply, the modulation transformer output voltage will cause the total voltage at the triode RF oscillator anode to vary between 1300 volts and 290 volts in accordance with the applied modulation signal. The power output of the RF oscillator will vary with the anode voltage and produce the desired modulated RF output. The AM OVERLOAD indicator provided is a peak voltage indicator consisting of a resistive voltage divider and a neon lamp. The resistive divider samples the oscillator anode voltage and reduces a 1300 volt anode voltage to 82 volts which is just sufficient to ionize the neon lamp. Hence, when the neon lamp flashes, the peak anode voltage applied to the oscillator is equal to 1300 volts, and the peak RF output is equal to the RF output that would be obtained if 1300 DC were applied to the oscillator.

7.5 PULSE Function.

EXT. PULSE input jack J401 is connected through S404B to pin 11 of C307B. Q307B amplifies and shapes the external pulse input and drives Q309 to turn the oscillator tube on during the pulse input period.

8. PROTECTIVE CIRCUITS

8.1 High VSWR Trip.

Voltage from the directional coupler in the RF oscillator

module is applied to differential amplifier Q310A. This voltage level is set to 100mV at 10 watts reflected power by an adjustment in the oscillator module. Reference adjust control R325 is set to trip the fault switch when the RF reflected power exceeds 10 watts. When this level is reached, the output of Q310A goes high turning fault switch Q308 on.

8.2 Anode Current Overload.

The negative supply lead of the high voltage power supply is connected to circuit ground through a 10 Ohm anode current sense resistor R314. This resistor establishes a voltage proportional to the anode current which is applied to the differential amplifier Q307A by ANODE CURRENT OVER-LOAD ADJ. control R316. This level is set to operate the fault switch when anode current exceeds 225mA.

8.3 Excess Grid Current Indicator.

Grid current is sensed by 27 Ohm resistor R357 between the grounded grid of the oscillator tube and circuit ground. Voltage developed across this resistor operates differential amplifier Q310B which turns on indicator driver transistor Q306. When Q306 turns on, the GRID O'LOAD lamp lights to indicate excessive grid current. R348 adjusts the point at which the lamp will light.

8.4 Grid Current Overload.

Voltage across Grid Current Sense Resistor R357 also turns on gird current overload transistor Q308B which applies the negative sensing voltage to the base of cathode modulator transistor Q309. This reduces bias on Q309 limiting current through the RF oscillator tube by increasing the tube bias voltage.

8.5 Fault Switch.

When a high is present from the high VSWR trip or anode current overload, SCR Q308A turns on reducing the input voltage of gate Q307C resulting in the READY/RESET relay being turned off. Q308A remains on until the READY/RESET switch is operated, removing anode voltage from Q308A allowing the circuit to reset.

9. RF OSCILLATOR MODULES (Refer to the schematic diagram at the end of this manual)

All oscillator modules are electrically similar with exceptions in the grid shunt resistor and filament/cathode isolation circuits. The MCL Models 6047 through 6050 do not use the grid current shunt resistor. The MCL Models 6051 and 6052 use a 200 Ohm resistor which shunts the 27 Ohm sensing resistor R357 on the control circuit board to allow the circuit to measure and sense a maximum of 40mA grid current. RF power from the oscillator flows through the RF directional coupler to the RF OUT panel connector. The directional coupler provides decoupled DC outputs to measure forward power in the 15 watt and 100 watt

TITLE:

ranges, and reflected power in the 15 watt range. Power is applied to the module through a multi-pin connector J at the rear of the module. A jumper between pins 3 and 4 of this connector provide an interlock to prevent the system from operating if the module is removed.

10. RF POWER METERING

The DC output from the directional coupler in the oscillator module is connected through 15 W - 100 W meter range switch S406 and FWD-RFL switch S405 to the RF POWER meter M401. Meter calibration control R416 adjusts the meter for a full scale deflection with 100mV input. Calibration of the 100mV signal for both forward power ranges and the reflected power range is controlled by potentiometers in the RF oscillator module.

J403

115VAC INPUT

CB401
CB402

ON-OFF

S402

HEATER REGULATOR

+15V

K701 THERMAL RELAY

1
2
4
11
10
6

EXT. MA

J402

MODULATING SWITCH

AM 2 VOLT

POWER SUPPLY

+15V UNREG. SOURCE

+15V SOURCE

2
10
2

TP303 (BLU)

+15V REG. SOURCE

+15V UNREG. SOURCE

+55V UNREG SOURCE

TP302

TP304 (BLK) CTK GND.

TP305 (WHT) 6.00V RFF

RF OUTPUT POWER ADJ

ANODE CURRENT OVERLOAD ADJ.

R314 ANODE CURRENT RESET

—	15122		
NEXT ASS'Y	USED ON	NEXT ASSY	
APPLICATION		QTY. RE	

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
A	ORIGINAL	12/17/73	RTB

OSCILLATOR MODULE

RF SAMPLE

DIR COUPLER

RF OUT

POWER METER

+15V

MODULATOR

HIGH VOLTAGE

TIMER

+15V UNREG

DS402 READY

DS404 GRID O'LOAD

DS405 ON

GRID CURRENT OVERLOAD

FAULT SWITCH

RESET RELAY DRIVER

22

GRID CURRENT MODULATOR

P

FUNCTIONAL BLOCK DIAGRAM

ITEM	PART NO.	QTY.	DESCRIPTION	MAT'L.	MAT'L. SPEC.

LIST OF MATERIAL

DO NOT SCALE:

UNLESS OTHERWISE SPECIFIED	DRAWN	DS	12/17/73
DIMENSIONS ARE IN INCHES TOLERANCES FRACTIONAL ± DECIMAL ± ANGULAR ±	CHECKER	RTB	12/17/73
MATERIAL:	MECH. ENGR.		
SPEC:	ELEC. ENGR.	RTB	12/17/73
FINISH:	PROJ. ENGR.	RTB	12/17/73
SPEC:	CHIEF ENGR.		

SCALE: FF | WEIGHT AUT. CALC. | SHEET OF

MCL INC
10 NORTH BEACH AVENUE
LAGRANGE, ILLINOIS 60525
312-354-4350

32C1496

TITLE:

CALIBRATION

1. GENERAL

This section is to be used for recalibration of the equipment only after adequate performance tests are made to verify malfunction. Recalibration of controls is not normally required due to the inherent high stability of the solid state devices used in the system. If adjustment is required after replacement of components, the following procedures should be observed.

Set the MODULATION switch to CW, FWD-RFL switch to FWD, and 100 W - 15 W range switch to 100 W unless otherwise instructed. Other controls will be set as required. Connect a 50 Ohm RF load to the RF OUT connector and the RF SAMPLE connector. Refer to the system schematic diagram, RF Oscillator Module schematic diagram, and Figure 2 -- location of test points and calibration controls, for information regarding test points and adjustments.

2. RF POWER METER

2.1 Meter Calibration.

Apply a 100mV DC level to the FWD-RFL switch S405 test point B. Adjust the meter calibration control R416 located on the back of the meter for full scale deflection.

2.2 Forward and Reflected Power Ranges.

Adjust the RF POWER OUTPUT ADJ. control for 15 watts output as indicated on an external power meter. Adjust the 15 watt

calibration control in the RF oscillator module for full scale deflection of the power meter.

2.3 100 Watt Forward Power Range.

Set the RF POWER OUTPUT ADJ. control for the maximum specified power output of the oscillator module in use and adjust the 100 Watt meter calibration control to read the correct power on the RF POWER meter.

2.4 Reflected Power Range.

Connect the generator to a mismatched load with a 2:1 VSWR. This can be done using a "T" in the RF output line and two 50 Ohm loads connected in parallel. Slowly increase the RF output power until 5 watts reflected power is indicated on the external power meter. Adjust the reflected power calibration control in the RF oscillator module for a 5 watt reading on the power meter.

3. HIGH VSWR TRIP

Using the same equipment setup as in paragraph 2.4 continue to increase the RF power until the reflected power reaches 10 watts. The VSWR trip circuit should activate the fault switch and place the unit in a fault condition (READY/RESET light out). To set the trip level, adjust VSWR trip level control R325 on the control circuit board.

TITLE:

4. ANODE CURRENT OVERLOAD

4.1 Equipment Setup.

Remove the RF oscillator module and connect a jumper to pins 3 to 4 of J404 to complete the interlock circuit. Connect a variable current source of 0 - 225mA minimum to pin 16 of the control circuit board with the positive lead connected to circuit ground. Set the RF POWER OUTPUT ADJUST control to OFF and turn the system ON. Increase the current source until 225mA is reached. The anode current overload circuit should place the unit in a fault condition at this time. If this does not occur, adjust the Anode Current Overload Adjust control R316 on the control circuit board until the fault switch operates.

5. GRID CURRENT OVERLOAD

5.1 Preliminary Connections.

Remove the RF oscillator module and connect a jumper between pins 3 and 4 of J404. Connect 0 - 40mA current source with the negative lead at pin Z and the positive lead at circuit ground. Adjust the RF POWER OUTPUT ADJ. control to OFF and turn the system ON.

5.2 Adjustment.

Increase the current source starting from 0 and until 30mA is reached. This level should cause the GRID O'LOAD indicator to light. Further increase in current will be

evidenced by reduced bias on the base of the cathode modulator transistor Q309. To set the GRID O'LOAD indicator level, adjust the Grid Current Indicator Adj. control R348 on the control circuit board. This should be adjusted to light the lamp at a 30mA current. Connect a voltmeter to the base of Q309 and adjust grid overload adj. control R366 until the base voltage just begins to drop at 30mA.

6. HIGH VOLTAGE POWER SUPPLY ADJUST

6.1 Preliminary Adjustment

With the unit OFF, connect an Ohmeter between the wiper of HV Reference Set control R402 and circuit ground at TP304. Turn the unit ON and adjust Amplifier Reference Control R312 for 6.0 volts at Pin 2 of Q305.

6.2 Adjustment

Connect a voltmeter from the anode lead of the Oscillator Module to circuit ground. Adjust the RF POWER OUTPUT ADJ. control for an indication of 100 on the panel. Adjust the High Voltage Set control R403 for a reading of 960 volts on the meter.

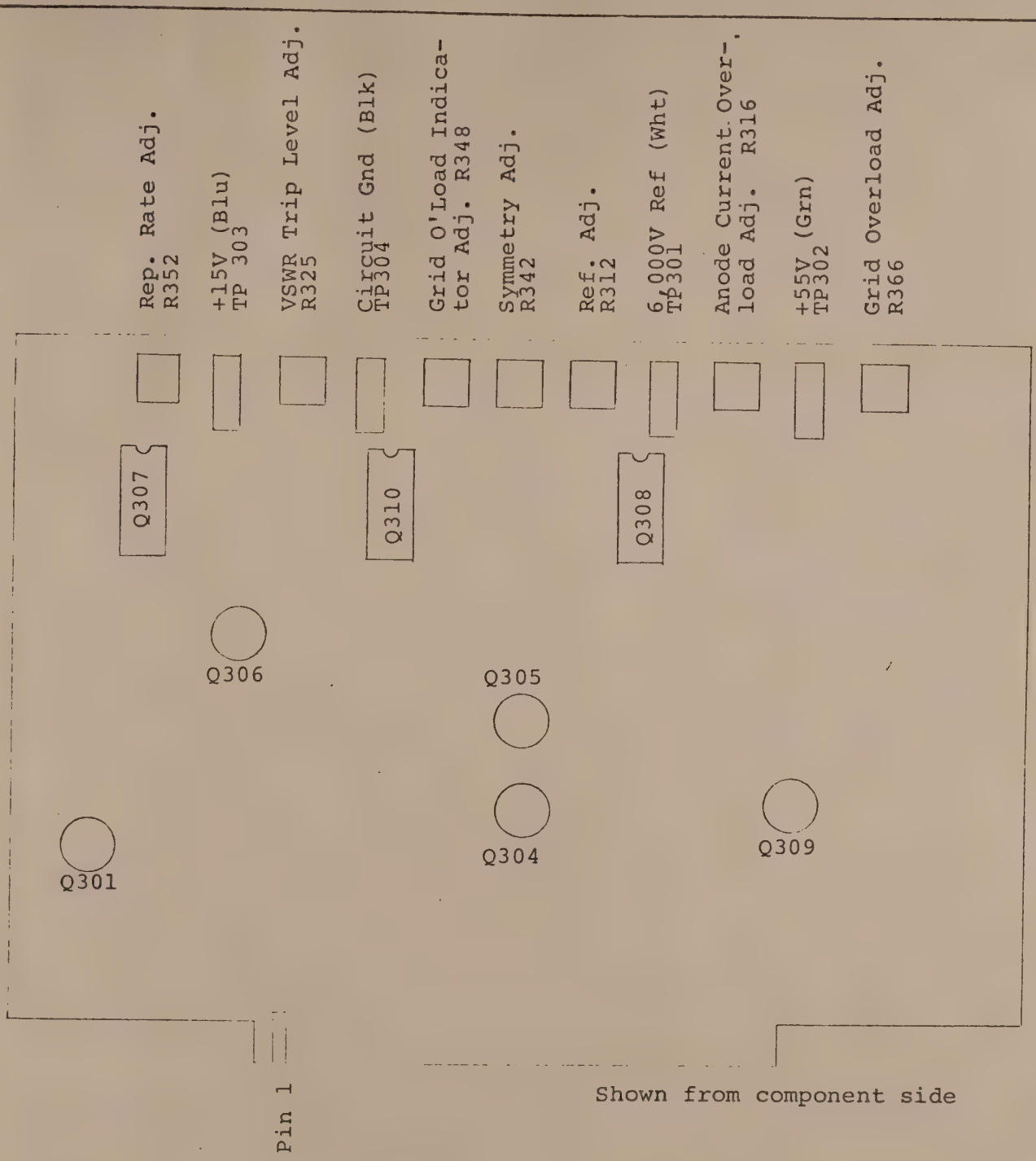
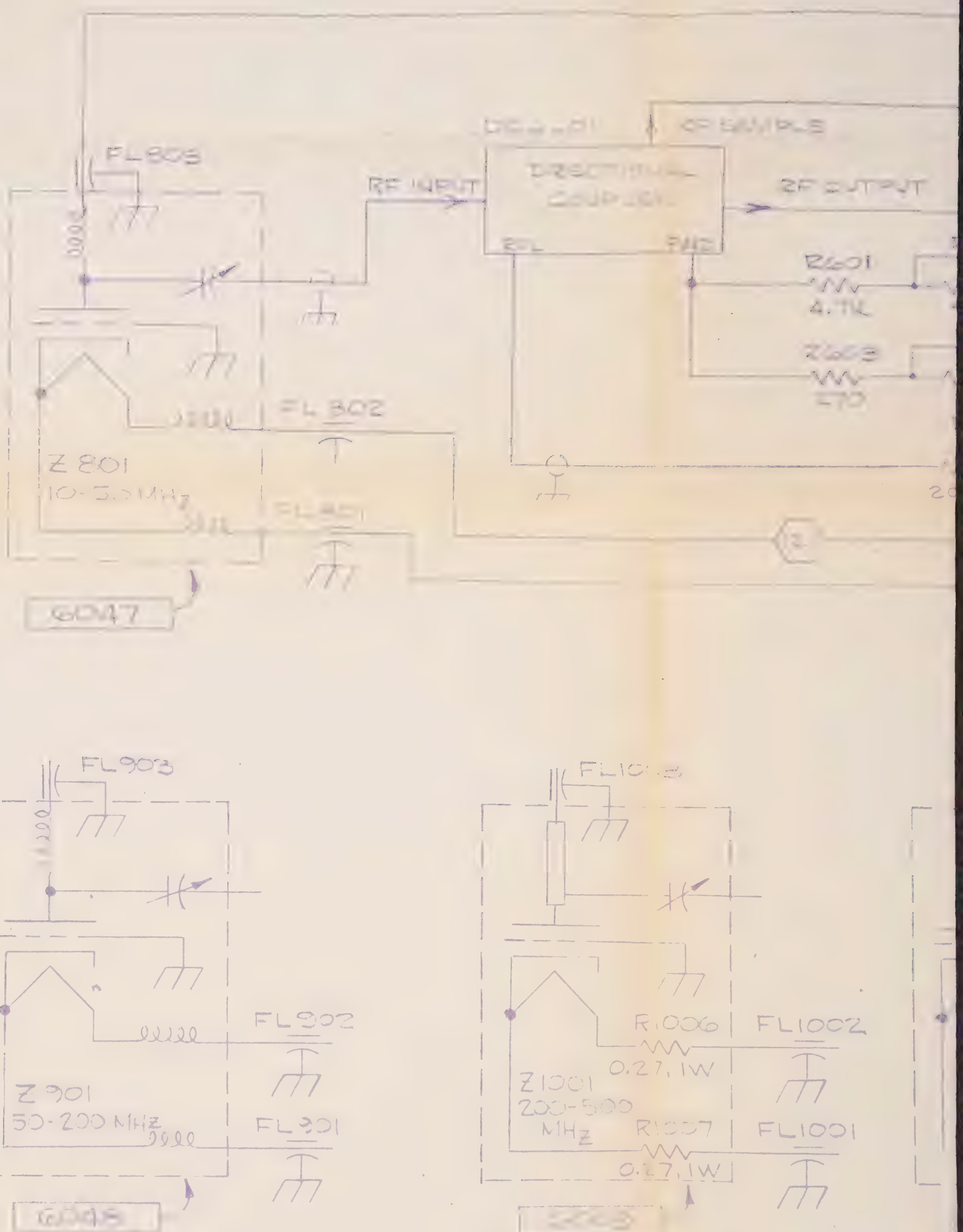


Figure 2

Location of Test Points And Calibration Controls



NOTES:

1. RF OSCILLATOR CAVITIES 6043 THRU 6052 & 6051 ARE SHOWN ABOVE
2. NOT USED ON MODELS 6051 & 6052, J--01 PIN 6 IS LEFT OPEN IN THIS CASE
3. EARLIER MODELS MAY USE FIXED, FACTORY SELECTED RESISTORS FOR 15W, 75W AND REFL METER CALIBRATION

6151	6151	REF
6052	6052	"
6051	6051	"
6050	6050	"
6049	6049	"
6048	6048	"
6047	6047	"
NEXT ASSY	USED ON	NEXT ASSY
APPLICATION		QTY. R

E	REVISED	DS	4/3/76
F	R604 & R605 VALUE CHANGE	EE	1-27-76

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVAL
A	ORIGINAL, RAK	11-19-75	[illegible]
B	PIN 7 WAS 8 PIN 8 WAS 7 ; R604 WAS R602 ; R602 WAS R604 ; 75W WAS 15W ; 15W WAS 75W 7PM	12/31/75	7PM
C	22GA. WAS 20 GA. 18GA ; ADDED ⏚ ON PIN 10 7PM	1/6/76	7PM 4480
D	REVISED DS	2/26/76	4422

WIRING CODE

BLACK	0
BROWN	1
RED	2
ORANGE	3
YELLOW	4
GREEN	5
BLUE	6
VIOLET	7
GRAY	8
WHITE	9

ALPHA 1630-218

A1 ANODE VOLTAGE P/O J--01

RG53/U — RF SAMPLE J--03

RG142B/U — RF OUT J--02

P/O J--02

R602 75W CAL. NOTE 3 — 3122 — 7 — 75W PWR. MTR.

R604 15W CAL. NOTE 3 — 3122 — 8 — 15W PWR MTR

R605 RFL. CAL. NOTE 3 — 3122 — 9 — RFL TO PWR. MTR.

3122 — 5 — VSWR TO TRIP

1 — FROM FILAMENT SUPPLY

3122 — 12 — 2 CATHODE

3122 — 13 — 11 MODULATION INPUT

R606 50Ω — 3122 — 6 GRID SHUNT — SEE NOTE 2

3122 — 10 CHASSIS GROUND

4 INTERLOCK

3 INTERLOCK — #22GA. BUSS

FL1103 — R1106 0.51, 2W — FL1102 — Z1101 400-1000MHz — FL1101 — 6050

FL1203 — R1206 0.51, 2W — FL1202 — Z1201 1000-2000MHz — FL1201 — 6051 — 6151

FL1303 — R1306 0.39, 2W — FL1302 — Z1301 2000-2500MHz — FL1301 — 6052

ITEM	PART NO.	QTY.	DESCRIPTION	MAT'L	MAT'L. SPEC.

LIST OF MATERIAL

DO NOT SCALE:

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES FRACTIONAL ±
DECIMAL ±
ANGULAR ±

MATERIAL: SPEC.

FINISH: SPEC.

FINAL ASSY

EQ'D.

DRAWN	RAK	Nov. 19 '75
CHECKER		
MECH. ENGR.		
ELEC. ENGR.	DTB	11/21/75
PROJ. ENGR.		
CHIEF ENGR.		

MCL Models 6047 - 6052 & 6151 RF Oscillator Modules (Schematic)

SCALE: WEIGHT ACT. CALC.

MCL INC
10 NORTH BEACH AVENUE
LAGRANGE, ILLINOIS 60525
312-354-4350

3201486

SHEET OF

TITLE:

PARTS LIST

MCL 6047 - 6052 and 6151* Oscillator Modules

The following parts are common to all modules:

Ref. Symbol	Description	Part Number	Manufacturer
R601	4.7K, ½W	RC20GF472J	
R602	Potentiometer, 7.5K	3006P-1-752	Bourns
R603	270, ½W	RC20GF271J	
R604	Potentiometer, 50K	3006P-1-503	Bourns
R605	Potentiometer, 2.5K	3006P-1-252	Bourns
R606	150, ½W	RC20GF151J	

MCL 6047 RF Oscillator Module

Z801	Cavity Oscillator	D6047	MCL
	Oscillator Tube	23C1322	MCL
DC 801	Directional Coupler	23C1888 or 23C1331	MCL
L801, L802	24uH	4626	J.W. Miller

MCL 6048 RF Oscillator Module

Z901	Cavity Oscillator	D6048	MCL
	Oscillator Tube	27C1323	MCL
DC901	Directional Coupler	27C1187 or 27C1332	MCL
L901, L902	3.3uH	SWD3.3	Nytronics

*Supercedes Model 6051

TITLE:

MCL 6049 RF Oscillator Module

Ref. Symbol	Description	Part Number	Manufacturer
Z1001	Cavity Oscillator	D6049	MCL
	Oscillator Tube	27C1324	MCL
DC1001	Directional Coupler	27C1186 or 27C1333	MCL
R1001, R1002	0.27 Ohm, 2W	BWH	IRC

MCL 6050 RF Oscillator Module

Z1101	Cavity Oscillator	D6050	MCL
	Oscillator Tube	27C1325	MCL
DC1101	Directional Coupler	27C1183 or 27C1334	MCL
R1101	0.51 Ohm, 2W	BWH	IRC

MCL 6051, 6151 RF Oscillator Module

Z1201	Cavity Oscillator	D6051, D6151	MCL
	Oscillator Tube	27B1201	MCL
DC1201	Directional Coupler	27C1250	MCL
R1201	0.51 Ohm, 2W	BWH	IRC

MCL 6052 RF Oscillator Module

Z1301	Cavity Oscillator	D6052	MCL
	Oscillator Tube	27B1201	MCL
DC1301	Directional Coupler	27C1232	MCL
R1301	0.39 Ohm, 2W	BWH	IRC

TITLE:

PARTS LIST

MCL 15222 MAINFRAME

Ref. Symbol	Description	Part Number	Manufacturer
	BLOWER		
B401	Axial Vane 115V Axial Vane 230V	30B1723 30B1685	MCL MCL
	CAPACITOR, Fixed, uF unless stated		
C401, C402	75,450V	39D756F450JT4	Sprague
C403	4000, 15V	39D4086015JL4	Sprague
C404	0.33, 12V	HY375	Sprague
C405, C406	75, 450V	39D756F450JT4	Sprague
C407	Not used		
C408 - C410	.0033, 600V	6PS-D33	Sprague
C411 - C414	75, 450V	39D756F450JT4	Sprague
	CIRCUIT BREAKER		
CB401	5 Amp	30B1725	MCL
	DIODE		
CR401	Rectifier, Silicon bridge	BR830A	Diodes, Inc.
CR402	Rectifier, Silicon, 1A, 50 PIV	IN4001	Motorola
CR403	Rectifier, Silicon bridge	MDA-922-1	Motorola
CR404	Zener, Silicon, 5.1V	IN5231	Motorola
	LAMP		
DS401, DS403	Indicator, LED, red	MLED660	Motorola

TITLE:

Ref. Symbol	Description	Part Number	Manufacturer
	LAMP (Con't.)		
DS402	Indicator Assembly, neon	51-N6-CWO	Data Display
DS404	Indicator Assembly, LED, red	51-R2-CRO	Data Display
	FILTER		
FL401	Feedthrough, 12 section	1212-554	Erie
FL402	Feedthrough, high voltage	1280-060	Erie
	CONNECTOR		
J401, J402,	Coaxial, BNC type, female 2 contact, ¼" phone type, shorting	UG625/u C12A	Switchcraft
J403	AC line, male	7486	Hubbell
J404	12 Contact, female	DPX-13HV1-33S	Cannon
J405	Printed Circuit Card Connector, 44 contact, female	R644	Vector
	RELAY		
K401	SPDT, 24V, 470 Ohm coil	388CQX-3	Magnecraft
	COIL		
L401	Choke, Filter	23C1321	MCL
	METER		
M401	RF Power Indicating, 0-15 Watts and 0-100 Watts	28B1209	MCL
	TRANSISTOR		
Q701, Q702	NPN, silicon	DTS801	Delco
Q703-Q706	NPN, silicon	2N3439	

TITLE:

Ref. Symbol	Description	Part Number	Manufacturer
	RESISTOR, Ohms ± 10%, 2W, fixed, unless specified		
R401	50K, 25W	270-0224	Ohmite
R402	Potentiometer	LW10K	Mallory
R403	Potentiometer	J197	Allen Bradley
R404	560	RC42GF561K	
R405	560	RC42GF561K	
R406	100, ± 5%, ½W	RCR20G101JS	
R407	87.5K, 60W	HL-60-87.5K	Dale
R408	10K, ¼W	RC07GF103K	
R409	1K, ½W	RC07GF102K	
R410	10K, ¼W	RC07GF103K	
R411	Not used		
R412	100 Ohm, 12W	270-3778	Ohmite
R413	220	RC42GF221K	
R414-R417	220K ± 5%, 1W	RCR32G224JS	
R418	15K, ½W	RC20GF153K	
R419-R421	56K	RC42GF563K	
R422-R425	220K, ± 5%, 1W	RCR32G224JS	
R426	Potentiometer, 500	3059J1-501	Bourns
R427	10K, 12W	270-3826	Ohmite
R701	9.1K, ± 5%	RCR42G912JS	
R702	10K, ± 5%	RCR42G103JS	
R703	11K, ± 5%	RCR42G113JS	
R704	12K, ± 5%	RCR42G123JS	
R705	12K, ± 5%, ½W	RCR20G123JS	

TITLE:

Ref. Symbol	Description	Part Number	Manufacturer
	SWITCH		
S401	dpst, momentary	22AC2	Microswitch
S402	dpst, momentary	7201J62BI	C + K
S403	dpst, momentary, lever	7108J62BI	C + K
S404	3 pole, 6 position, rotary	B15022-10	MCL
S405	dpdt, slide	46206LSR	Switchcraft
S406	spdt, momentary, slide	46203MR	Switchcraft
	TRANSFORMER		
T401	High Voltage Power Supply	23C1320	MCL
T402	Low Voltage Power Supply	23D1238	MCL
T403	Adjustable, 115VAC Adjustable, 230VAC	23C1197 23C1194	MCL MCL
T404	Filament Supply	23B1267	MCL
T405	Modulation	23B1199	MCL
	NON-REFERENCED ITEMS		
	Panel, front	D15122-21	MCL
	Panel, top used with: fastener, stud ring, lock	B15022-32 82-11-220-16 82-32-101-17	MCL Southco Southco
	RFI Honeycomb Grill	A15122-16	MCL
	Filter, air, aluminum mesh	19B1405	MCL
	Line cord	24926	Columbia
	Line cord connector	7484	Hubbell
	Knob, RF Power Output Adj.	9F2L	Nat'l Radio
	Knob, Modulation	7F2L	Nat'l Radio
	Optional Slides		MCL

TITLE:

PARTS LIST

MCL C-15222-1 CONTROL CIRCUIT BOARD
(Reference C-15122-1)

Ref. Symbol	Description	Part Number	Manufacturer
	CAPACITOR, Fixed, uF, unless stated		
C301	50, 25V	TE1209	Sprague
C302	0.1, 100V	225P10491WD3	Sprague
C303	230, 25V		Mallory
C304	0.1, 100V	225P10491WD3	Sprague
C305	.0015, 1KV	5GAD15	Sprague
C306	15, 15V	TE1089	Sprague
C307	50, 25V	TE1209	Sprague
C308	56, 15V	CSR13D566KL	Mallory
C309	.022, 100V	225P22391WD3	Sprague
C310	Not used		
C311	50, 100V	WH11D506F100R	Sprague
C312	100, 25V	TE1211	Sprague
C313	0.33, 100V	225P33491XD3	Sprague
C314	50, 100V	WH11D506F100R	Sprague
C315	.001, 50V	CY15C102M	Centralab
C316	.01, 100V	CY15A103M	Centralab
C317-C319	1.0, 50V	CY30C105M	Centralab
C320	1.0, 12V	TE1120	Sprague
	DIODE, Rectifier		
CR301-CR303	Bridge, silicon, 1A	MDA920-3	Motorola

TITLE:

Ref. Symbol	Description	Part Number	Manufacturer
	DIODE, Rectifier (con't)		
CR304-CR309	Silicon, 1A, 50 PIV	IN4001	Motorola
	SEMICONDUCTOR DEVICE		
Q301	Integrated Circuit, Voltage Regulator, 12V	78L12C	Fairchild
Q302	Not used		
Q303	Optical Isolator, LED - phototransistor type	MCT-2	Monsanto
Q304	Integrated Circuit, Voltage Regulator, 15V; incl. heatsink, Wakefield 207CB	78M15HC	Fairchild
Q305	Integrated Circuit, differential power amplifier	CA3094T	RCA
Q306	Not used		
Q307	Integrated Circuit, comparator	MC3302P	Motorola
Q308	Integrated Circuit, transistor, SCR , put array	CA3097	RCA
Q309	Transistor, NPN, silicon; incl. heatsink, Wakefield 207CB	2N5321	RCA
Q310	Integrated Circuit, comparator	MC3302P	Motorola
	RESISTOR, Ohms ± 5%, ¼W, fixed, unless stated		
R301	Not used		
R302	1.3K	RC07GF132J	
R303	Not used		

TITLE:

Ref. Symbol	Description	Part Number	Manufacturer
R304	100K	RC07GF104J	
R305	Not used		
R306	4.7K	RC07GF472J	
R307	6.8K	RC07GF682J	
R308	560	RC07GF561J	
R309	2.2M	RC07GF225J	
R310	300, 2W	RC42GF301J	
R311	3.3K	RC07GF332J	
R312	Potentiometer, 20K	ZV2032	Allen Bradley
R313	39K	RC07GF393J	
R314	10, 1W	RC32GF100J	
R315	1.8K	RC07GF182J	
R316	Potentiometer, 1K	ZV1022	Allen Bradley
R317	3.3K	RC07GF332J	
R318	100	RC07GF101J	
R319	6.8K	RC07GF682J	
R320	5.6K	RC07GF562J	
R321	10K	RC07GF103J	
R322	150K	RC07GF154J	
R323	15K	RC07GF153J	
R324	5.11K ± 1%	RN50C5113	
R325	Potentiometer, 5K	ZV5022	Allen Bradley
R326	10M	RC07GF106J	
R327	3.3K	RC07GF332J	

TITLE:

Ref. Symbol	Description	Part Number	Manufacturer
R328	39K	RC07GF393J	
R329	1K	RC07GF102J	
R330	1K	RC07GF102J	
R331	56K	RC07GF563J	
R332	3.3K	RC07GF332J	
R333	1K	RC07GF102J	
R334	1K	RC07GF102J	
R335	27K	RC07GF273J	
R336	680	RC07GF681J	
R337	1.8M	RC07GF185J	
R338	10K	RC07GF103J	
R339	1.5M	RC07GF155J	
R340	12K	RC07GF123J	
R341	11K	RC07GF113J	
R342	Potentiometer, 50K	ZV5032	Allen Bradley
R343	33K	RC07GF333J	
R344	1.82K ± 1%	RN50C1823	
R345	15K	RC07GF153J	
R346	10M	RC07GF106J	
R347	100K	RC07GF104J	
R348	Potentiometer, 5K	ZV5022	Allen Bradley
R349	10K	RC07GF103J	
R350	560, 1W	RC32GF561J	
R351	2.2K	RC07GF222J	
R352	Potentiometer, 100K	ZV1042	Allen Bradley

TITLE:

Ref. Symbol	Description	Part Number	Manufacturer
R353	100K	RC07GF104J	
R354	1K	RC07GF102J	
R355	10K	RC07GF103J	
R356	470	RC07GF471J	
R357	27, 1W	RC32GF270J	
R358	1K, 2W	RC42GF102J	
R359	1K, 2W	RC42GF102J	
R360	22, 1W	RC32GF220J	
R361	560	RC07GF561J	
R362	100K, ¼W	RC07GF104J	
R363	100, 1W	RC32GF101J	
R364	1K	RC07GF102J	
R365	10M	RC07GF106J	
R366	Potentiometer, 500	ZV5012	Allen Bradley

NOTE: Parts listed which do not indicate a manufacturer are common registered types available from various sources.

TITLE:

115 to 230VAC CONVERSION

Line Volt	CB401 CB402	B401	T401	T402	T403	T404
115V	5A Note	Note	Connect line 1 to 2 & 5, line 2 to 4 & 1.	Connect line 1 to 2, line 2 to 1.	Note	(TB401 connections) Connect line 1 to 3 & 4 Line 2 to 1 & 2.
230V	3A Note	Note	Connect line 1 to 5, jumper 2 to 4, line 2 to to 1.	Connect line 1 to 3, line 2 to 1.	Note	(TB401 connections) Connect line 1 to 3, jumper 2 & 4, line 2 to 1.

NOTE: See parts list for type number.

Attachment "A"

38A1207

SHEET 1 OF 1

MCL/INC
DESIGNERS AND MANUFACTURERS OF RF COMPONENTS AND SYSTEMS
TEN NORTH BEACH • LA GRANGE ILLINOIS 60525 • 312-354-4350